



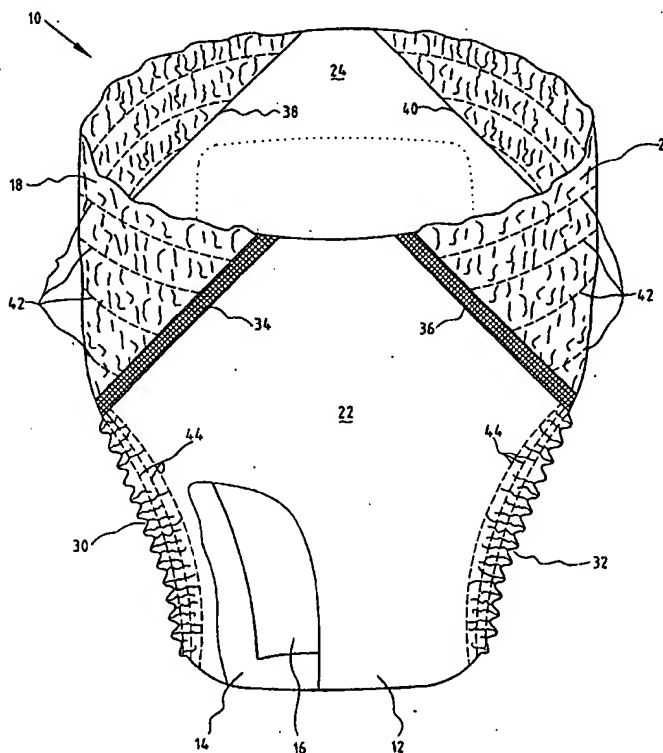
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: DISPOSABLE TRAINING PANT, APPARATUS AND METHOD FOR MANUFACTURING IT

## (57) Abstract

A disposable pant diaper (10) with an external layer (12) which is impermeable to liquids, an internal layer (14) which is permeable to liquids, and an absorbent pad (16) which is inserted between the external layer (12) and the internal layer (14), which are made to adhere to each other. Two tensioned elastic waistbands (18, 20) rest longitudinally on the internal layer and are permanently fixed to the opposite ends by means of bonding lines (34, 36, 38, 40). The elastic waistbands form the elasticated and densely gathered lateral parts that lie transversely to the absorbent pad in order to wear the diaper like conventional underpants.



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## DISPOSABLE TRAINING PANT, APPARATUS AND METHOD FOR MANUFACTURING IT DESCRIPTION

10 The present invention relates to the field of disposable absorbent diapers for children and adults.

More particularly, the present invention relates to disposable absorbent diapers of the type shaped like pants closed around the waist with an elasticated waistband and to the apparatus and method for manufacturing said disposable pant diapers.

15 Disposable absorbent diapers are by now widely appreciated among consumers and are currently used by children during their first years of life and by adults suffering from different incontinence problems. The typical disposable product, which is well-known in the state of the art, is composed of a structure with three main layers, such as an internal liquid-permeable layer which is in contact with the body, an external covering layer which is impermeable to the liquid, and an absorbent pad which is interposed  
20 between the internal layer and the external layer. The materials currently generally used for the three main elements of disposable diapers include various kinds of non-woven fabric, a thin plastic sheet for the external covering layer, and cellulose pulp subjected to defibration, known as fluff, for the absorbent pad. The non-woven fabric is a comfortable, non-irritating material suitable for direct contact with the skin, which  
25 allows the liquids to filter through to the absorbent pad. The typical absorbent pad is made of cellulose pulp subjected to defibration and mixed with superabsorbent polymers.

The impermeable external layer is generally a thin sheet of plastics which does not allow the urine and feces that deposit inside the diaper during normal use to escape from said diaper.

30 These three basic layers that compose the absorbent diaper are generally glued together by hot-melt adhesive which, by being distributed in various manners on the inner faces of the various layers, joins them into a single product.

Disposable absorbent diapers are currently produced with various particularities, such as: two elasticated regions at the leg openings; elasticated lateral containment barriers to prevent the escape of liquid and solid substances from the lateral leg openings; elasticated containment barriers located at the front and rear part of the diaper in order to prevent the escape of substances in the waistband region; various kinds of elastic tapes arranged at the waistband in order to increase the comfort and fit of the diaper; various kinds of mechanical elasticated lateral closures of the tear-open type or using conventional adhesive tapes, arranged in the rear part of the diaper, which fasten, so as to allow repositioning, onto the tape arranged in a front position on the diaper; elasticated external layers to improve fit; one or more sheets of hydrophilic material arranged between the non-woven fabric and the absorbent pad, with the purpose of rapidly distributing the received liquids to the whole surface of the absorbent pad; various types of anatomical shaping in the region between the legs, both in the absorbent pad and in the layers of plastic and non-woven fabric. These are some of the main characteristics that can be encountered in current absorbent diapers and are well-known to all the experts in the field.

All these innovations have been applied to absorbent diapers in the course of several years of development, with the purpose of making absorbent diapers increasingly comfortable to wear and suitable to perform their main task of absorbing and containing the liquid and solid substances produced by the body.

The market of disposable absorbent diapers is generally divided into products for children and products for adults, which are in turn divided into various sizes in order to be able to adapt to the various body sizes of the users.

Products for children are divided into three main categories: ordinary open-sided absorbent diapers; absorbent pant diapers, which are closed at the sides, are very similar to conventional pants, have a limited absorbent capacity and are generally known in the diaper sector as training pants; and absorbent pant diapers which are similar to training pants and are likewise closed at the sides but have a high absorbent capacity and are generally known in the diaper sector as pant diapers.

Normal open absorbent diapers are more widespread than pant diapers; they are generally used from birth until the child has complete control over urinary and fecal functions.

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The pant-like diapers known as training pants having a low absorbent capacity are used for relatively short periods, when the child is beginning to gain control over body functions.

5 The pant-like diapers known as pant diapers having a high absorbent capacity are generally used instead of normal open-sided absorbent diapers during the various stages of growth.

Normal diapers are generally flat items which are open at the sides and are wrapped around the child by overlapping portions of the sides which are fastened together, for example, with a piece of contact adhesive or other conventional mechanical fixing  
10 systems which are well-known in this field; to wear or remove this diaper it is necessary to act on the two lateral closure systems.

Training pants and pant diapers have closed sides so as to form a closed and elasticated waistband which, by way of this elastic function, allows to put on and take off the diaper like normal pants, without having to act on lateral closures, and to  
15 automatically adapt to the size of the waist of the child.

Training pants have been devised by considering, in toilet-training psychology, that the child is toilet-trained more easily by wearing diapers of the pant-like type, similar to the underwear used by adults.

Pant diapers have been devised by thinking of a product which is very comfortable  
20 and easy to wear, automatically adapts to the body of the child, and is meant to be used not only during the last period of diaper use, like training pants, but to replace conventional open-sided diapers.

The adult incontinence market generally provides three main types of disposable diaper in various sizes according to the body size of the person for which they are meant.

25 One type is a flat open-sided diaper meant to be wrapped around the person; it is fully similar to conventional child diapers in terms of construction technology and the sides are kept closed, for example by adhesive labels, after wrapping it around the waist of the person.

This type of open-sided diaper for adults is typically used for hospitalized adults.

30 Another type is the disposable absorbent pant diaper: in terms of construction technology and functional characteristics, it is similar to pant diapers for children, obviously scaled up so that it can be worn by adults.

This diaper is put on and worn like normal pants and has closed sides so as to form a closed and elasticated waistband which, by way of this elastic function, allows the diaper to be worn and taken off without difficulty like normal pants and to automatically adapt to the size of the waist. Absorbent diapers for adults of this type are generally known as adult pants or incontinence pants.

Another type of disposable adult diaper is constituted by a central absorbent body which is generally elongated and arranged between the legs of the incontinent person and is folded in a U-like shape, so that the front part adheres to the belly and the rear part adheres to the waist; this diaper is kept snugly in contact with the body by means of two applied and detachable lateral elastic waistbands which connect the two lateral parts of the diaper.

This absorbent diaper for adults provided with a waistband is cheaper than the closed pant diaper, but it has the drawback that it is less comfortable than adult pants and is more conspicuous when worn.

Generally, the waistbands are applied to, and can be detached from, the front and rear panels of the covering layer with buttons and buttonholes or by fixing with Velcro or other conventional systems.

It is believed that the habit of using the toilet can be psychologically encouraged, for children, by the fact that the child perceives that the disposable pant-like item of underwear is more similar to the nondisposable underwear used by adults than to the normal open disposable diaper and the child is therefore encouraged to abandon the use of ordinary disposable diapers and to acquire control over his or her body functions.

Basically, adult pants have been devised to facilitate better fit and functionality of the product but most of all to psychologically assist adults in tolerating the discomfort of incontinence as nontraumatically as possible, making them feel as normal as possible; this reasoning leads to the fact that it is thought that incontinent adults prefer to have a disposable absorbent diaper which is as similar as possible to ordinary nondisposable pants.

It is generally not normal for an adult to wrap himself in an open-sided item of clothing and fix it with adhesive tape or to have pants to be fixed with a waistband and buttons or other similar systems.

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As regards the functional aspect, conventional open-sided absorbent diapers and pant diapers closed at the sides substantially perform the same basic functions, i.e., to absorb and contain, for some time, the urine and feces of the body.

5 However, the fit, comfort and resemblance to normal pants cause the disposable diaper closed at its sides to be much better and preferred with respect to the conventional open diaper.

Unfortunately, the production cost of closed pant diapers is considerably higher than the cost of conventional diapers; accordingly, closed pant diapers both for children and for adults are niche products which are not accessible to most people in view of their  
10 high cost.

This higher cost is caused by several factors.

Closed pant diapers have, in the leg opening regions, elasticated sections which are substantially perpendicular to the elasticated sections of the waistband; accordingly, during the manufacturing process at least one of these orientations is in contrast with the  
15 normal direction of manufacture of the diaper and therefore the manufacturing operations must first correspond to one of the orientations in order to produce one part of the diaper and then, with a complicated physical handling, the manufacturing operations must aim at transverse orientation in order to complete the product.

The transverse movement and the positioning of components of flexible products at  
20 high production rates cause the manufacturing operations to be considerably complicated.

All the diapers must be constructively identical within a limited tolerance range; accordingly, the higher the complexity of the process, the higher the number of rejects produced in order to maintain a constant quality level; therefore the production costs are  
25 higher than those of normal diapers.

Furthermore, the typical production rate for pant diapers closed at the waist is slower than the production rate of normal open-type diapers, again because of the fact that the closed pant diaper requires much more complicated manufacturing technologies.

Furthermore, the costs of special elasticated materials used in the pant diaper to  
30 ensure good fit for the user contribute to considerably increase the cost of pant diapers with respect to the cost of current open diapers.

On the basis of these considerations, the need arises to provide improved disposable diapers of the closed pant-like type with an elasticated region in the waistband which allows to wear them easily like normal underpants and at the same time is able to reduce the costs for their manufacture to levels which make them accessible to most people.

5        This is the aim of the present invention.

The present invention meets the need of this sector by providing improved disposable closed pant diapers closed with elastic waistbands and an apparatus and a method for manufacturing said pant diapers.

10       This new diaper comprises an external sheet which is impermeable to liquids, an internal layer which is permeable to liquids, an absorbent pad inserted between the external layer and the internal layer, a series of elastic elements applied under tension in the region of the leg openings, and a pair of elastic waistbands applied under tension longitudinally with respect to the working direction of the machine, longitudinally with respect to the absorbent pad, longitudinally with respect to the elastic threads applied at  
15       the leg openings, above the internal layer and firmly fixed to the opposite ends thereof, the entire assembly being kept together by applying hot-melt adhesive in specific gluing regions.

During use of the diaper, the elastic waistbands, which lie longitudinally to the absorbent pad during manufacture, delimit the upper closed edge of the diaper and  
20       arrange themselves transversely to the absorbent pad.

The present invention provides an apparatus for producing a disposable pant diaper which is closed at the waistband by means of two elastic elements: it includes a section for forming the main mat composed of a plurality of materials, which receives a long and continuous impermeable external protective layer to which a series of elastic elements  
25       under tension have been applied with hot-melt glue; said elastic elements, generally threads, are applied continuously in the two internal lateral parts of the impermeable external ribbon; a long and continuous permeable internal protective layer; a continuous series of absorbent pads which are all mutually separated and spaced by the same distance and are inserted between the internal layer and the external layer. Said layers  
30       are mutually joined by hot-melt glue in order to form a ribbon of consecutive diapers.

Two tensioned elastic waistbands are arranged longitudinally above the internal layer on the opposite sides of the mat. The elastic waistbands comprise at least one sheet of



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material on which tensioned elastic elements are applied; the release of the elastic elements defines the gathered and elasticated regions in the waistband.

A fixing device rigidly fixes the elastic waistbands to the mat at preset intervals proximate to the end regions of each diaper on the line.

5 A cutting device cuts the mat at preset intervals in order to separate each diaper from the continuous line.

When the waistbands, with their elastic under tension, are released from said tension, the elastic elements return to the length they had before being tensioned; this causes the two lateral elasticated bands to assume a transverse position with respect to the central ribbon with the absorbent pad, delimiting the elasticated regions of the waistband; by closing transversely to the absorbent pad, the two elasticated bands, together with the central ribbon to which they have been attached, delimit the appropriately provided leg openings, which also are elasticated.

10 The present invention provides a method for manufacturing absorbent pant diapers which includes: the step for forming a continuous mat of an external covering layer which is impermeable to liquids, an internal layer which is permeable to liquids, a series of absorbent pads interposed between the two layers, the entire assembly being made to adhere together as a single mat; the step for superimposing on the upper layer in the mat two tensioned elastic waistbands which are arranged longitudinally to the mat and are tensioned and separated and arranged on the opposite sides thereof; the step for the rigid coupling of a pair of tensioned elastic waistbands to the mat at preset intervals, in order to delimit the seam between the elastic waistbands and the mat; the step for cutting the mat and the elastic waistbands along a line which is spaced outside the coupling regions; and the step for dividing the mat into separate disposable absorbent pants.

25 The elasticated waistbands, applied longitudinally to the mat, delimit a diaper which is substantially cup-shaped and is of the pant-like type, in which the elasticated waistbands delimit the upper layer of the open end of the diaper, said elasticated regions being substantially transverse with respect to the absorbent pad and delimiting, together with the lateral regions of the mat, the opposite leg openings of the diaper.

30 Objects, advantages and characteristics of the present invention will become apparent from the following description of the invention and from its claims with reference to the accompanying drawings, wherein:

figure 1 is a detailed perspective view of the disposable pant diaper according to the present invention;

figure 2 is a schematic view of a production line for the disposable pant diaper of figure 1 according to the present invention;

5 figure 3 is a schematic detailed view of a thermal bonding roller and of a contrast roller for producing the disposable pant diaper of figure 1 according to the present invention;

figure 4 is a schematic detailed view of a cutter and a contrast cutter for manufacturing the disposable pant diaper of figure 1 according to the present invention;

10 figure 5 is a partially sectional top view of a part of the mat adjacent to the thermal bonding roller for manufacturing the disposable pant diaper of figure 1, according to the present invention;

figure 6 is a top view of part of the mat of figure 2, showing the operation of the cutting roller for manufacturing the disposable pant diaper of figure 1 according to the present invention.

15 With reference to the drawings, in which identical parts bear identical reference signs, figure 1 is a partially sectional perspective view of the pant diaper 10 according to the present invention.

20 The pant diaper 10 comprises a body which is formed by an impermeable external layer 12, a permeable internal layer 14, an absorbent pad 16 interposed between them, and two opposite elasticated waistbands 18 and 20.

25 The body forms a front panel 22 and a rear panel 24 which are joined by the two opposite elasticated waistbands 18 and 20, which form the elasticated lateral panels and delimit the suitably provided opposite leg openings 30 and 32, where elasticated threads are provided.

In the illustrated version, the longitudinal opposite sides of the absorbent pad 16 form two arc-like hollows 17 (see figure 2) between the front and rear ends of the pads 16.

In practice, the hollows 17 delimit the leg openings 30 and 32 in order to provide a better anatomical fit of the diapers 10.

30 The joining lines, constituted for example by thermally bonded regions 34 and 36 to the sides of the front part of the panel 22, and the joining lines constituted, for example, by thermally bonded regions 38 and 40 to the sides of the rear part of the panel 24 join

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the elasticated waistbands 18 and 20 to the front part and to the rear part of the absorbent panel.

As shown in the partially sectional view of figure 5, the waistbands 18 and 20 include a series of tensioned elastic elements 42 so as to substantially form continuous elasticated gathered portions when, once the production process has been completed, they are released from the working tension and return to their initial size, thus forming an elasticated region in the waistband of the pant diaper.

Furthermore, a series of elastic threads 44 is provided in the peripheral region of the leg openings 30 and 32 in order to substantially form continuous elasticated portions around the leg openings in the pant diaper 10.

Figure 2 is a schematic perspective view of a line 50 for manufacturing the diaper 10 shown in figure 1.

The ribbons of the material for the impermeable layer 12 and the permeable layer 14 are supplied continuously from the respective rolls.

The ribbons of the external layer 12 and of the internal layer 14 pass adjacent to the respective gluing head 56, 58 and pass over the respective feeder roller 60, 62 to reach a pair of mating rollers 64.

A continuous series of separate and spaced absorbent pads 16 is inserted between the lower ribbon 12 and the upper ribbon 14.

The waistband forming station 70 forms the elasticated waistbands 18 and 20 for the waistline starting from a ribbon 72 of material.

Preferably, the material is non-woven fabric, but it can be a woven fabric or other fabric suitable to mate or couple to the mat 89 formed by the impermeable layer 12 and the permeable layer 14 and to form elasticated sections therein, as explained hereafter.

The station 70 comprises a gluing head 74 and a feeder roller 76 for the elastic elements 42.

The feeder roller 76 receives a group of longitudinally tensioned and spaced elastic elements 42 from a feeder.

The feeder roller 76 is externally covered with non-stick material to prevent it from being soiled by the glue.

Tensioning of the elastic elements 42 is provided by virtue of mechanisms which are conventionally known in the field.

Two mutually opposite folding bars 78 receive the lateral parts 77 of the mat 72.

The folding bars 78 fold the lateral parts 77 over the median parts 79, forming an elastic sandwich 81.

The elastic sandwich ribbon 81 then advances toward the parting roller 80.

5 The cutter 82 is mounted so as to be adjacent to the roller 80.

By virtue of the action of the cutter 82, the elastic sandwich ribbon 81 is parted into two parts in order to form the elastic waistbands 18 and 20.

Two guiding bars 84 and 86 direct the waistbands 18 and 20 to the feeder roller 88. The feeder roller 88 transfers the elastic waistbands 18 and 20 to the insertion roller 87 and to the mat 89 formed by the lower external layer 12, the upper internal layer 14 and, between the two layers, the separate absorbent pads 16 and the tensioned elastic threads 44.

The guiding bars 84 and 86 also align the external margins of the waistbands 18 and 20 with the respective external margins of the mat 89.

15 The waistbands 18 and 20, which are tensioned so as to tension the elastic elements, are applied above the upper internal layer 14 of the mat 89 and form a composite mat 90.

A thermal bonding roller 92 and a contrast roller 93 receive the composite mat 90.

The roller 92 comprises two thermal bonding elements 94 which protrude from the surface of the roller (shown more clearly in figure 3).

20 The thermal bonding elements 94 form bonded regions in the mat 90 at selected intervals in order to fix the waistbands 18 and 20 to the mat as described hereafter.

A cutting roller 95 and a contrast roller 97 are arranged after the thermal bonding roller 92 and its contrast roller 93.

25 The cutting roller 95 and the contrast roller 97 receive the mat 90 with the waistbands 18, 20 already fixed by the thermal bonding regions produced by the thermal bonding roller 92 and by the contrast roller 93.

In the version shown in figure 5, the thermally bonded regions are the bonding lines 34, 36 and 38, 40.

30 The cutting roller 95 comprises the cutters 120 for cutting the mat 90 outside the thermally bonded regions 34, 36 and 38, 40, at the same time producing a transverse central cut between said thermally bonded regions.

The action of the cutters separates the individual pant diapers 10a from the mat 90.

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The extractors 98 are arranged on the opposite sides of the line 50 in order to remove the waste 100.

A separation belt 102, subjected to suction, receives the diapers 10a which are now complete and conveys them to a stacking unit (not shown).

5        Figure 3 is a detailed view of the thermal bonding and contrast rollers 92 and 93 of the preferred version.

The thermal bonding roller 92 comprises the two thermal bonding elements 94, whose thermal bonding surface 106 lies on the outside of the roller.

10        In the illustrated version, each one of the thermal bonding elements 94 has supports 108 and 110 arranged at an oblique angle with respect to the longitudinal axis 112 of the roller 92.

The supports 108, 110 are preferably orientated at angles of 45° with respect to the longitudinal axis 112. The supports 108, 110 therefore substantially form a right angle 114 between them.

15        A layer of soft rubber 115 generally covers the roller 92 except on the thermal bonding elements 94.

The layers of rubber 115 cooperate by keeping the mat 90 flat during thermal bonding.

Figure 4 is a detailed view of the cutting roller 95 and of the contrast roller 97.

20        The cutting roller 95 includes a cutter 120 which is formed by two V-shaped mirror-symmetrical sections 122 and by a transverse section 124.

The cutter 120 protrudes from the cutting roller 95.

25        The two sections 122 correspond to the shape of the thermal bonding elements 94 and therefore each one of the sections 122, in the illustrated version, is orientated so as to form a substantially right angle 125.

The blades 122 of the cutter 120 cut the mat 90 outside the thermally bonded regions formed by the rollers 92 and 93 so as to separate the waste 100 from the mat 90; at the same time, during the rotation of the cutting roller 95 and contrast roller 97, the blade section 124 fully separates the individual diapers 10 from the continuous mat 90.

30        A layer of soft rubber 126 generally covers the roller 95 except on the cutter 120-124 and helps to keep the mat 90 flat during cutting.

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Figure 5 is a sectional top view of part of the mat 90 arranged adjacent to the thermal bonding roller 92 and to the contrast roller 93 (which are not illustrated in the figure).

The mat 90 comprises the lower layer 12, with a series of elastic threads 44 which run longitudinally and in the working direction of the line of the machine 50.

5       The upper ribbon 14 covers the separate absorbent pads 16 and the elastic threads 44, superimposing on the lower ribbon 12.

The ribbons that form the elastic waistbands 18 and 20 are mutually separated so as to have a distance 130 along the longitudinal axis of the mat 90.

10       The distance 130 can vary from 0.00 mm for small child diapers to 300 mm and more for large-size adult diapers.

15       In large-size diapers, a conventional rotary cutting system formed by a cutter and a contrast cutter (not shown in the drawings) and arranged between the presser rollers 64 and the roller 87 for inserting the elastic waistbands 18, 20 cuts two lateral sections of the mat 89 formed by the upper ribbon 14 and by the lower ribbon 12 outside the elastic threads 44.

Cutting occurs only in the central external region, preferably at the recesses 17 on the absorbent mat 16; the two cut parts are removed in the meantime by suitable waste extractors.

20       A mat 89 is thus provided which instead of having two straight external sides become hourglass-shaped at the recesses 17 in the absorbent mat 16.

The sequence of lateral cuts along the edges of the mat 89 must not coincide with the part of the mat 89 dedicated to the thermal bonding of the elastic waistbands 18 and 20; this operation is performed in order to make the product more comfortable at the leg openings, especially for larger-size pant diapers or diapers for adult incontinence.

25       The elastic waistbands 18 and 20 are located above the upper ribbon 14 and comprise the elastic elements 42.

The thermal bonding roller 92 and the contrast roller 93 form the thermally bonded regions 34, 36 and 38, 40, which join the elastic waistbands 18 and 20 to the mat 90.

30       Figure 6 is a top view of a portion of the mat 90 that is adjacent to the cutting roller 95 and of its corresponding contrast roller 97 (which are not shown in the figure).

Figure 5 illustrates the cuts provided in the mat 90 by the cutting roller 95 and by its corresponding contrast roller 97 in order to separate the diapers 10 from the continuous ribbon 90.

5 With respect to the thermally bonded regions, the cuts are parallel and spaced and lie outside the thermally bonded regions 34, 36 and 38, 40 so as to maintain the integrity of the mating of the elastic waistbands 18 and 20 with the part of the mat 90 that corresponds to the front and rear panels 22 and 24.

The cuts also separate the waste 100 from the mat 90.

10 A disposable pant diaper 10a according to the present invention is shown separated from the continuous line 90 and so is the waste 100.

The production of the disposable pant diapers 10 according to the present invention is now described with particular reference to figure 2 and to other figures as mentioned hereafter.

15 The outer covering ribbon 12 supplied from its own roll (not shown) moves in the working direction of the line and is kept at the correct working tension by suitable systems which are well-known in this field and passes adjacent to the gluing head 56, which distributes hot-melt adhesive on the internal side of the ribbon.

20 The ribbon 12 can be a plastic film, a laminated element constituted by plastic film and external non-woven fabric, or by a composite laminated element, or by a film which is microporated but impermeable to liquids with an external surface made of non-woven fabric; these are materials conventionally used in the field.

The elastic threads 44 are applied continuously in the working direction of the ribbon 12 to the internal part of the ribbon 12 and are fixed thereto with hot-melt adhesive, keeping them under tension.

25 The ribbon 12 moves beyond the feeder roller 60 longitudinally to the working direction of the machine toward the presser rollers 64.

The absorbent pads 16 are deposited longitudinally on the ribbon of the external covering layer 12 so that they are continuously and constantly equidistant with respect to the speed of the line.

30 The absorbent pads 16 are preferably obtained with a conventional forming apparatus which is commonly available in diaper manufacturing lines; these systems are well-known in the field.

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The internal covering ribbon 14, supplied from its own roll (not shown), moves in the working direction of the line and is kept at the correct working tension by suitable systems which are well-known in this field and passes adjacent to the gluing head 58, which distributes hot-melt adhesive onto the internal side of the ribbon.

5       The mat moves beyond the feeder roller 62 longitudinally to the working direction of the machine toward the presser rollers 64, which press together the external ribbon 12, with the corresponding elastic threads 44 applied thereto, the absorbent pad 16 and the internal ribbon 14.

10       By virtue of the hot-melt adhesive previously applied to the ribbons 12 and 14, the composite intermediate mat 89 thus forms.

As mentioned earlier, larger diapers can comprise recesses in the layer 12 and in the layer 14 of the mat 89. Said cavities correspond, in terms of shape and longitudinal position, to the cavities of the absorbent pads 16 as regards the transverse position with respect to the mat 89 and they are arranged on the outside of the elastic threads 44 in order to allow comfortable fit of the pant diaper.

15       The ribbons that form the elastic waistbands 18 and 20, kept at the correct working tension, are then positioned continuously and longitudinally with respect to the working direction of the machine on the intermediate composite mat 89 by the insertion roller 87.

20       In the illustrated version, the elastic waistbands 18 and 20 are formed simultaneously in the elastic waistband assembly station 70.

In any case, the present invention includes the option of forming the waistbands 18, 20 separately by means of two ribbons which are already separated when the forming of the elastic waistbands begins and are then separately supplied to the mat 89.

25       In summary, in the illustrated version the base ribbon 72 for producing the elastic waistbands is preferably provided in roll form, with a starting ribbon 72 which is four times the width of one of the waistbands 18 and 20.

The system folds one quarter of each one of the two opposite lateral parts of the ribbon 72 onto the two median parts, which are also equal to one quarter each, and then cuts the material into the two elastic waistbands 18 and 20.

30       In any case, in order to save material it is possible to fold the two lateral parts 77 of the ribbon so as to cover only the elastic elements 42 rather than the entire width of the waistband.



To describe in greater detail the forming of the elastic waistbands 18 and 20, the ribbon 72 of the elastic waistbands 18 and 20 receives the adhesive on one of its surfaces, which will subsequently become the internal surface of the sandwich, from the gluing head 74.

5       The tensioned elastic elements 42 move beyond the feeder roller 76, depositing onto the ribbon 72, to which they are fixed by the hot-melt adhesive.

The folding bars 78 cause the opposite lateral parts 77 of the ribbon 72 to fold onto the middle parts 79.

10       The adhesive on the surfaces of the folded sides 77 and the median parts 79 fixes the mat with the elastic elements 42 inserted under tension in between.

The sandwich 81 thus formed passes between the parting roller 80 and the cutter 82, which cuts the sandwich-like ribbon 81 along the longitudinal axis, forming the separate elastic waistbands 18, 20.

15       The guiding bars 84, 86 guide the separate elastic waistbands in a spaced arrangement whilst they move toward the insertion roller 87, passing over the roller 88.

The insertion roller 87 deposits the elastic waistbands 18, 20 longitudinally on the mat 89, thus forming the composite mat 90.

The external margin of the waistbands 18 and 20 is aligned with the respective external borders of the mat 90 by means of guiding bars 84, 86.

20       The mat 90 thus composed moves toward the heated thermal bonding rollers 92 and 93, passes through their plane of tangency and is thermally bonded in the preset regions.

The thermal bonding roller 92 and its contrast roller 93 also cooperate in maintaining the tension of the mat 90 composed of the various layers of ribbons and elastic elements 42 and 44.

25       With reference to figures 3 and 5, the thermal bonding rollers 92 and 93 join the elastic waistbands 18 and 20 to the mat 90 only in the preset regions.

30       The thermal bonding roller 92 and its contrast roller 93, by rotating, cause the thermal bonding faces 106 to make contact with the mat 90, which being interposed between the thermal bonding roller 92 and its contrast roller 93 receives intense pressure at the thermal bonding faces 106.

Accordingly, the heat and intense pressure between the rollers 92 and 93 bond the waistbands 18, 20 to the mat 90 along the thermal bonding lines 34, 36 and 38, 40.

The elastic waistbands 18 and 20 can be fixed with other means, such as adhesives, ultrasound systems, thermal systems or other fixing systems known in the field.

For example, a contoured layer of adhesive or a targeted spray of adhesive or a series of separate lines, spirals or spots of adhesive can be used to fix the waistbands 18, 20 along the lines 34, 36 and 38, 40.

Also within the scope of the aim of the present invention, the couplings, thermally bonded regions or joining lines that connect the elastic waistbands 18 and 20 and the front and rear panels 22 and 24 can be arc-shaped, can have discontinuous points or can form angles greater or smaller than approximately  $45^\circ$  with respect to the longitudinal axis, so long as the mating firmly couples the ends of the elastic waistbands 18, 20 to the panels 22, 24 so that the elastic waistbands constitute an annular elastic waistband for the diaper 10.

The couplings with adhesive, ultrasound, heat or other bonding mechanisms can equally provide spaced coupling points between the elastic waistbands 18 and 20 and the front and rear panels 22 and 24.

Thus, the thermal bonding regions 34, 36 and 38, 40 can be continuous sequences, as shown, or can be arc-like, curved, irregular, formed by connecting segments or formed by other geometries.

With reference to figures 4 and 6, the mat 90 with the waistbands 18 and 20 fastened at preset intervals to the thermal bonding regions 34, 36 and 38, 40 moves toward the cutting roller 95 and the respective contrast roller 97 in order to be separated into individual pant diapers 10 from the continuous line.

The cutting roller 95 turns so as to bring the cutter 120 into contact against the contrast roller 97; the mat 90 to be cut passes between the cutting roller 95 and its contrast roller 97.

While the rollers 95 and 97 turn, the blade 120 cuts the mat 90 outside the thermally-bonded regions 34, 36, 38, 40, thus separating the lateral waste 100; during rotation it also separates the pant diapers 10 from the mat 90 by virtue of the central section of the blade 124 which is arranged transversely to the orientation of the machine.

The blade 120 thus cuts both the diaper 10 and the waste 100 off the mat 90.

The extractors 98 are ordinary extractors which use suction to remove the waste of the cut 100 from the mat 90.

The suction-assisted separator belt 102 then carries the pant diaper 10 to a folding station (not shown), where the diapers are folded and packaged.

5 The method according to the present invention facilitates high production rates and low production rejects, because it allows to apply in a simple manner the elastic waistband 18 and 20 to the mat 89 in the same working direction as the machine, longitudinally to the absorbent panels 16 and longitudinally to the elastic threads 44 in order to elasticate the leg opening without transfers, rotations or crossed arrangements.

10 It is noted that the assembly station 70 is arranged substantially transversely with respect to the longitudinal line of the machine, and that the guiding bars 84 and 86 position the waistbands 18 and 20 for longitudinal application to the mat.

In an alternative version, the assembly station 70 is also aligned longitudinally and arranged vertically with respect to the line 50.

15 In the illustrated version, the rollers 92 and 93 are heated by electric resistors and join, by means of the heat and pressure between the rollers 92 and the contrast roller 93, the waistbands 18 and 20 and the mat 90 along the thermal bonding lines 34, 36 and 38, 40.

Fixing occurs only in the thermal bonding region, from the thermal bonding surface 106 through the mat 90 against the contrast roller 93.

In the preferred version, the circumference of the two rollers 92 and 93 is equal to the length of the diaper 10. The two rollers 92, 93 perform one turn per diaper.

20 The elastic elements 42 and 44 are preferably made of Lycra or other similar elastic material, natural or synthetic rubber; these are materials which are already currently used in the field.

25 The elastic elements 42 are fed to the roller 76 by stretching the elastic threads and then elongating them and keeping them under tension, so that the elastic elements 42, when they are fixed to the ribbon 72 by means of the adhesive, have a preset elongation.

The extent of the elongation of the elastic elements 42 is in the range between approximately 50% and approximately 350%; the elongation percentage is determined with respect to the dimensions of a portion of elastic thread at rest before applying tension in the waistbands 18 and 20.

30 In a preferred version, the elastic elements 42 are elongated by approximately 280%.

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The elastic threads 44 are preferably made of Lycra or other similar elastic material, natural or synthetic rubber; these are materials which are already currently used in the field.

5 The elastic threads 44 are fed by stretching and then elongating and keeping under tension the elastic threads, so that the elastic threads 44, when they are fixed to the ribbon 12 by means of the adhesive, have a preset elongation.

The elongation is preferably between 50% and 120%; the elongation percentage is determined with respect to the dimensions of a portion of elastic thread at rest before applying tension in the external ribbon 12.

10 The number of elastic elements 42, 44, their dimensions and their mutual spacing can be selected and adjusted so as to obtain the required force and fit results, as is well-known practice in the field.

15 The elastic elements can be configured so as to provide satisfactory elasticity in the elastic waistband portions 18 and 20; so can the contours of the leg openings 30 and 32 in order to act as barrier against leaks and so as to also avoid excessive irritations or marks on the skin.

20 Once the pant diaper 10 thus completed has been cut from the mat 90 and there is no longer any force keeping it tensioned and flat, the elastic elements 42 applied thereto under tension return to their original size, producing gathered regions in the elastic waistbands 18 and 20.

The return of the elastic elements 42 to their original length causes the flat pant diaper 10a to assume a cup-like shape, like a pair of pants which can be pulled up and taken down quickly, as would occur with ordinary pants.

25 During the production process, the elastic waistbands 18 and 20 in the mat 9 are arranged in a flat and outspread position, longitudinally with respect to the absorbent pad 16, to the elastic threads 44 and to the working direction; when the complete diaper 10 is cut from the mat 90 and the diaper is left free to return to the rest position, it passes from a substantially flat shape to a three-dimensional shape; the elastic waistbands 18 and 20 move around their thermal bonding lines 34, 36 and 38, 40 and move to a second position which is substantially transverse with respect to the central body of the pant  
30 diaper and to its components.

The lower margin of the elastic waistbands 18 and 20 forms the upper elasticated part of the leg openings 30 and 32.

In a preferred version, some of the elastic elements 42 are located on lateral parts of the elastic waistbands 18 and 20.

5        When tension is released, the lower border of the waistbands 18 and 20 forms gathered regions for the upper part of the leg openings 30 and 32.

The elastic threads 44 also return to their original length. This produces elasticated gathered portions on the border of the leg openings 30 and 32.

10       The diaper 10 folds along the transverse median axis, thus joining the opposite ends of the diaper.

The waistbands 18 and 20 orientate themselves substantially transversely to the absorbent pad 16 and form the parts of the open end of the pant diaper that wraps around the waistline of the person.

15       The elasticity of the elastic waistbands 18 and 20 allows elastic movement while the person pulls up or down the diaper 10 as necessary.

This same elasticity ensures a comfortable fit of the diaper.

The non-woven fabric 72, in the preferred version of the waistbands 18 and 20, allows air to reach the skin and is a soft surface in contact with the skin at the waist.

20       Other typical characteristics of disposable diapers are included without any problem in the pant diaper 10 according to the present invention, and the production line 50 is easily modified in order to include accessories for producing the elasticated lateral containment barriers known in the field as upstanding leg gathers or the application of a ribbon for the rapid acquisition of liquids, known as surge or acquisition layer, and other conventional applications used in current disposable diapers.

25       The waistbands 18 and 20, if made of material having suitable elastic properties, may provide sufficient elasticity without having to use elastic elements 42.

30       The principles, the preferred embodiments and the operating methods of the present invention have been described in the above description. The invention must not be construed as being limited to the particular embodiments that have been explained because said embodiments are meant to be nonlimitative examples.

Experts in this field may furthermore apply variations and modifications without abandoning the concept of the invention as described in the claims that follow.

## CLAIMS

1. A disposable diaper comprising an external covering layer which is impermeable to liquids; an internal layer which is permeable to liquids; multiple elastic threads in the leg opening regions, interposed between the external layer and the internal layer; an absorbent pad interposed between the external layer and the internal layer; characterized in that it comprises two elastic waistbands arranged longitudinally above the internal layer and are rigidly to the opposite ends of the diaper, wherein the elastic waistbands form lateral sections arranged transversely to the absorbent pad.

2. A disposable diaper according to claim 1, characterized in that said waistbands are fixed with reinforced couplings.

3. A disposable diaper according to the preceding claims, characterized in that said elastic waistbands comprise non-woven fabric with adhesive on the first surface; and a plurality of elastic elements, tensioned from a released position to a tensioned position and fixed to the non-woven fabric with the adhesive, wherein the elastic elements return to the released position in order to provide the gathering and elasticity in the elastic waistbands.

4. A disposable diaper according to one or more of the preceding claims, characterized in that said elastic waistbands comprise non-woven fabric with adhesive on the first surface; and a plurality of elastic elements which are tensioned from a released position to a tensioned position and remain fixed to the first surface of the non-woven fabric by means of the adhesive, wherein the non-woven fabric, folded along the longitudinal axis, forms a first layer and a second layer with the elastic elements interposed between them, said elastic elements returning to the released position in order to provide the gathering and elasticity in the waistband.

5. A disposable diaper according to one or more of the preceding claims, characterized in that said elastic waistbands comprise: a first layer of non-woven fabric with adhesive on the first surface; a second layer of non-woven fabric with adhesive on the first surface; and a series of elastic elements tensioned from a released position to a tensioned position, which are interposed between the first layer and the second layer and remain fixed to the first surface of the non-woven fabric by means of the adhesive, wherein the non-woven fabric, folded along the longitudinal axis, forms a first layer and

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a second layer with the elastic elements interposed between them, said elements returning to the released position in order to provide the elasticity in the waistbands.

6. A method for manufacturing a pant-shaped absorbent diaper, comprising the following steps:

5 (a) forming a continuous mat constituted by a layer which is impermeable to liquids, a layer which is permeable to liquids, and a plurality of absorbent pads interposed between the external covering layer and the internal covering layer, all of which are made to adhere to each other;

10 (b) superimposing on the upper permeable layer of the mat, in a longitudinal direction, two tensioned elastic waistbands which are arranged on the opposite sides thereof;

(c) fixing the pair of elastic waistbands to the mat at preset intervals in order to determine the couplings between the elastic waistbands and the mat;

15 (d) cutting the mat and the waistbands along a line that lies outside the couplings, thus separating the mat into separate pant diapers;

wherein the elastic waistbands, which have been inserted and attached longitudinally to the mat, substantially form a cup-shaped pant diaper in which the elastic waistbands form the lateral portions of an open end of the diaper, said portions being substantially transverse with respect to the absorbent pad and forming, monolithically with the lateral parts of the mat, the elasticated leg openings in the diaper.

20 7. A method according to claim 6, characterized in that said attaching step comprises the forming of the joining regions at oblique angles with respect to the longitudinal axis of the mat.

25 8. A method according to one or more of the preceding claims, characterized in that said attaching step comprises the joining of a portion of waistband to the mat substantially with an angle of 45° with respect to the longitudinal axis of the mat.

9. A method according to one or more of the preceding claims, characterized in that said attaching step comprises the thermal bonding of a portion of the elastic waistband to the mat.

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10. A method for manufacturing a pant-shaped absorbent diaper, comprising the steps of:

(a) forming a mat composed of multiple layers with a layer which is impermeable to liquids, a layer which is permeable to liquids, at least one absorbent pad interposed between the external covering layer and the internal covering layer, said mat being joined together by adhesive;

(b) applying two tensioned elastic waistbands waist on the permeable layer that lies on top of the mat, the elastic waistbands being arranged on the opposite sides of the mat; and

(c) rigidly fixing the pair of elastic waistbands to the upper layer of the mat along defined and spaced bonding regions which form oblique angles with respect to the longitudinal axis of the mat,

wherein the mat and the elastic waistbands attached thereto form a disposable pant diaper with sides closed by the elastic waistbands which form annular portions transversely to the absorbent pad and form, rigidly with the mat, the opposite leg openings therein.

11. A method for manufacturing a pant-like disposable absorbent diaper, comprising the steps of:

(a) providing a mat composed of multiple layers with a first width which comprises a layer which is impermeable to liquids, a layer which is permeable to liquids, a plurality of elastic threads in the leg passage regions, and at least one absorbent pad interposed between the external covering layer and the internal covering layer, fixed together by means of adhesive;

(b) providing two tensioned elastic waistbands above the permeable layer that lies above the mat, the elastic waistbands being arranged at the opposite sides of the mat, each waistband having a second width which is smaller than half of the first width; and

(c) fixing by attaching the pair of elastic waistbands to the respective edges of the mat along joining lines which form oblique angles with respect to the longitudinal axis of the mat;

wherein the mat and the elastic waistbands attached thereto form a disposable pant diaper with closed sides, with elastic waistbands which, when the tension of the elastic is released, form gathered and elasticated lateral parts of an annular element which lies



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transversely to the absorbent pad and form, together with the mat, the opposite elasticated leg openings therein.

12. A pant-like disposable diaper comprising:

5 (a) a mat composed of multiple layers, with a layer which is impermeable to liquids and is arranged in the lower region, a layer which is permeable to liquids and is arranged in the upper region, a series of elastic elements in the leg passage regions, and an absorbent pad inserted between the two, said components being fixed together by adhesive;

10 (b) two tensioned elastic waistbands above the permeable layer that lies on top of the mat, the elastic waistbands being arranged at the opposite sides of the mat; and

(c) couplings which fix the two elastic waistbands, at their respective ends, to the mat along lines which form oblique angles with respect to the longitudinal axis of the mat;

15 wherein the elastic waistbands, being thus coupled to the mat, form lateral portions of an open end of the diaper, said portions being substantially transverse with respect to the absorbent pad and forming, monolithically with the mat, the opposite elasticated leg openings in the diaper.

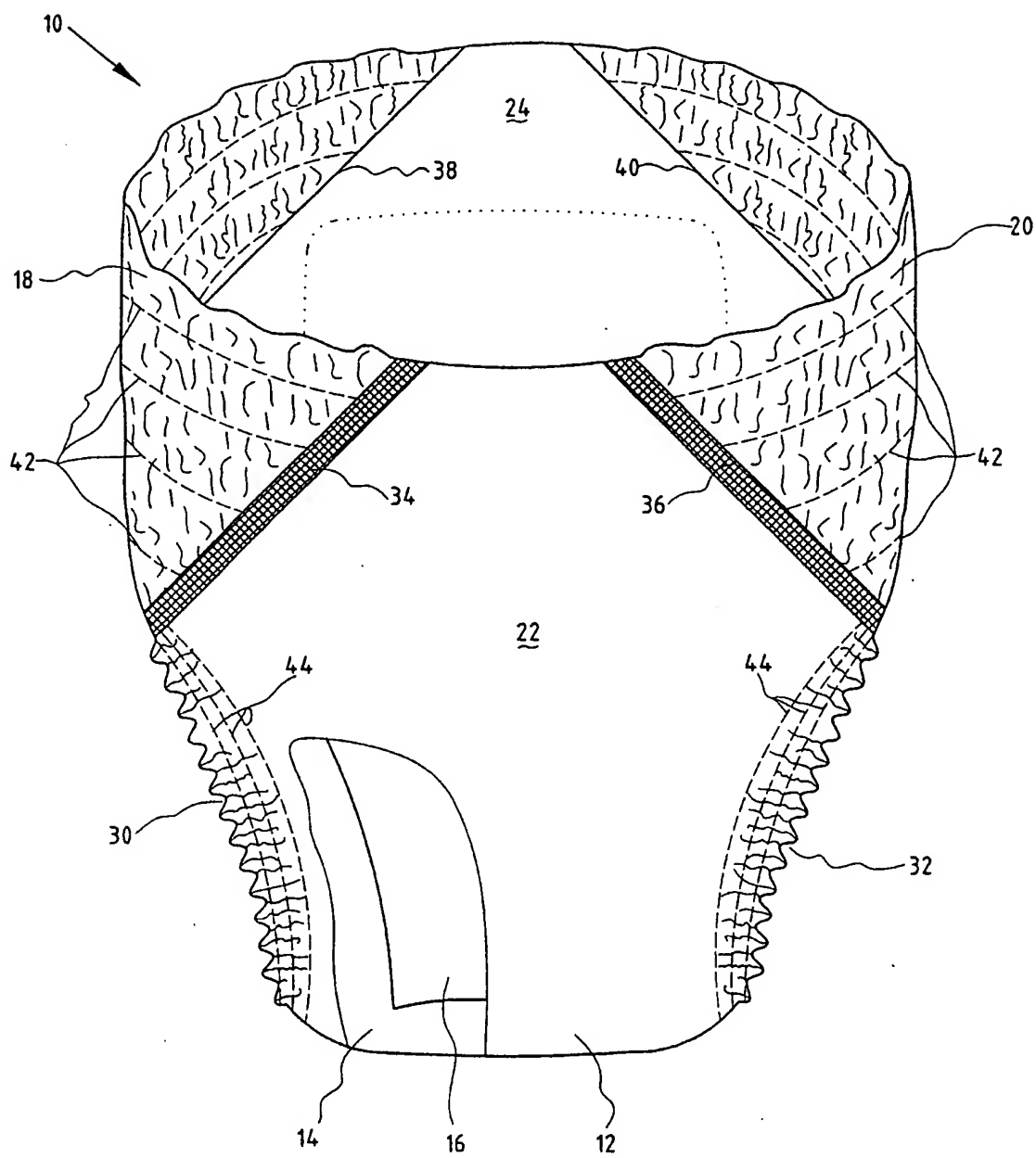
13. A disposable pant-like diaper as defined in claim 12, wherein the bonding regions comprise couplings which join the elastic waistbands to the mat.

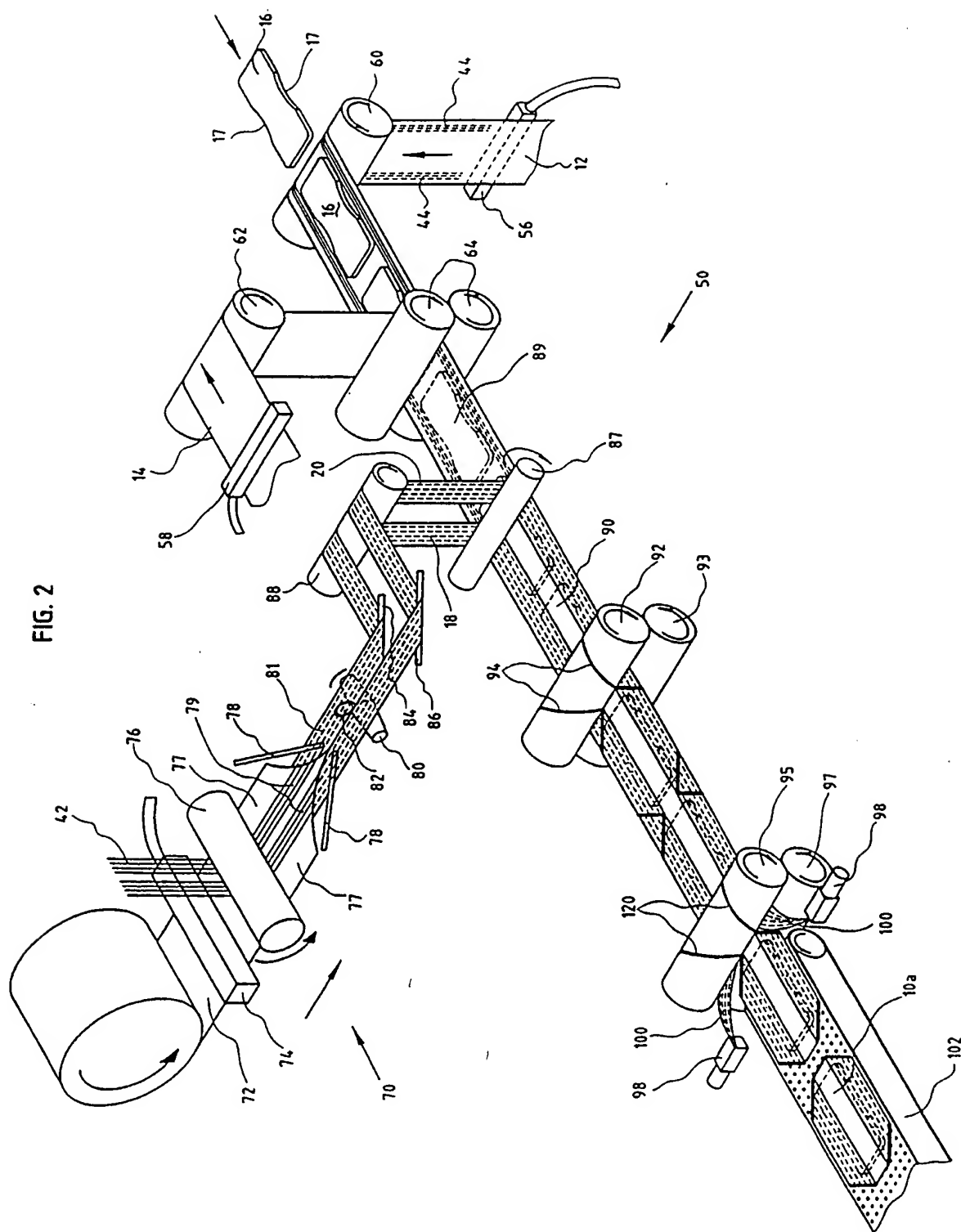
20 14. An apparatus for manufacturing a disposable pant diaper, comprising: a station for forming the mat, which receives a long strip of a layer which is impermeable to liquids, a long strip of a layer which is permeable to liquids, multiple elastic threads in the leg passage regions, and multiple separate absorbent pads inserted between the two layers, which are fixed together with adhesive in order to form a mat of consecutive diapers; means for providing two elastic waistbands which are superimposed on the  
25 upper permeable layer in the opposite lateral parts of the mat, the elastic waistbands comprising at least one layer with elastic elements, wherein the release of the tension of the elastic elements provides the gatherings and the elasticity in the elastic waist bands; a fixing system, which acts so as to firmly attach the elastic waistbands to the mat at preset intervals near the ends of each diaper in the mat; and a cutting device, for cutting  
30 the mat at preset intervals in order to separate each diaper from the mat, wherein the elastic waistbands, when their elastic is released, form lateral parts which are densely

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gathered transversely to the absorbent pad for the pant diaper and form, monolithically with the mat, the opposite elasticated leg openings in said diaper.

- 5 15. An apparatus for manufacturing a disposable pant diaper according to claim 14, wherein the means for providing the waistbands comprises: the provision of an amount of material in the form of a long strip; an adhesive applicator for applying adhesive to the first surface of the material in the form of a long strip; means for placing two separate series of a number of elastic elements on the adhesive on the material; two opposite folding wings for folding at least the opposite lateral parts of the material on the respective central region in order to superimpose on the elastic elements in the middle, 10 wherein the lateral and middle parts mutually join by means of the adhesive so as to form an intermediate long waistband; a cutter for parting the intermediate long waistband along its longitudinal axis so as to form two long waistbands; and guiding rollers for guiding the pair of long waistbands on the mat.

FIG. 1<sup>1/4</sup>



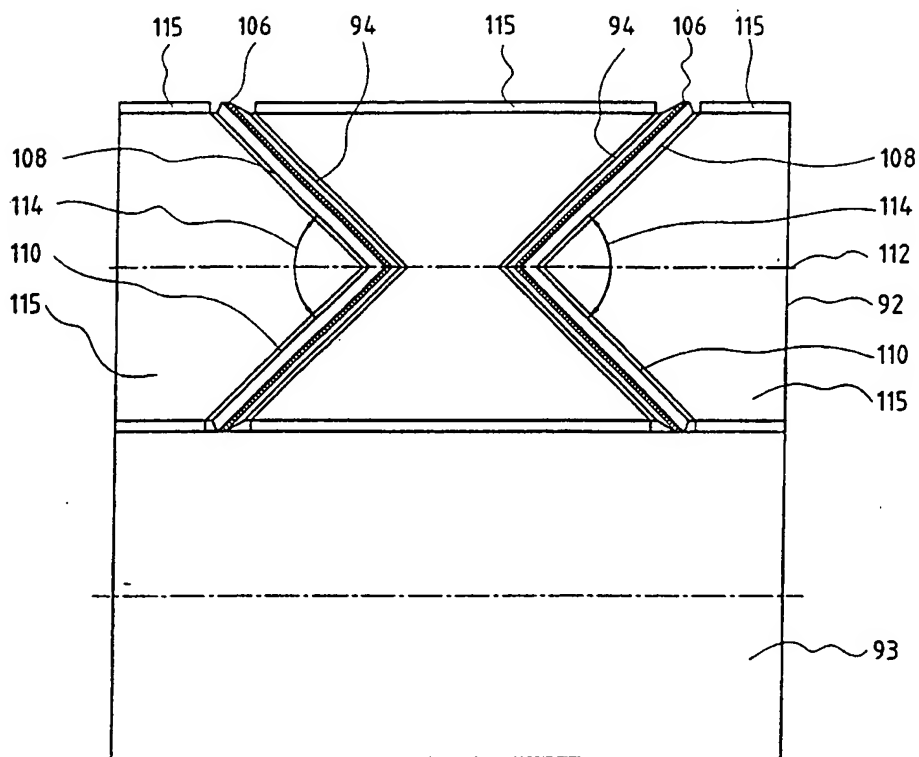


FIG. 3

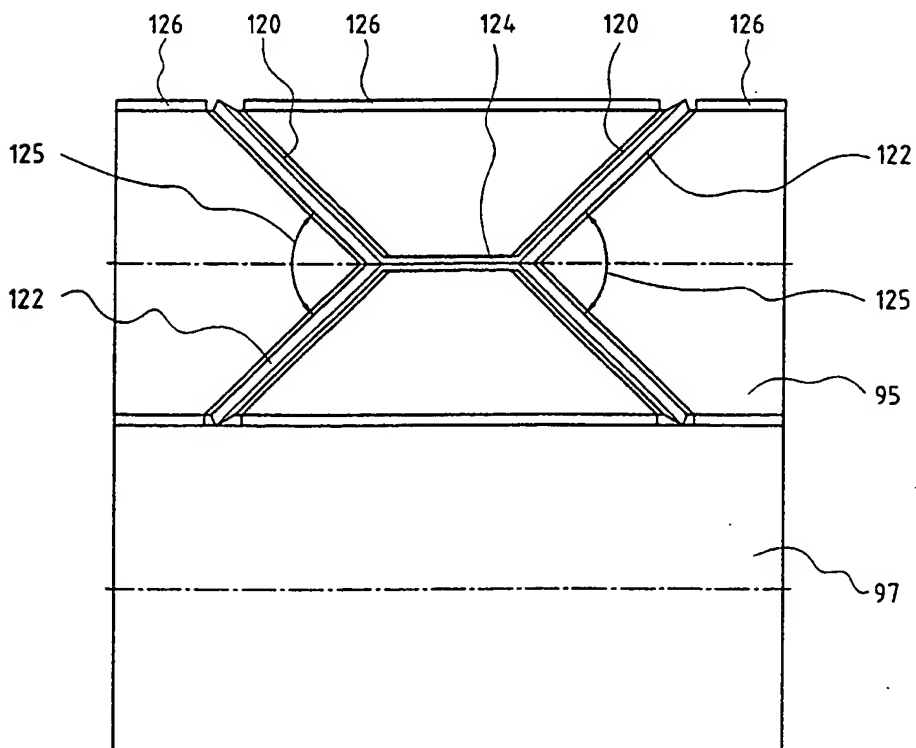


FIG. 4

FIG. 5

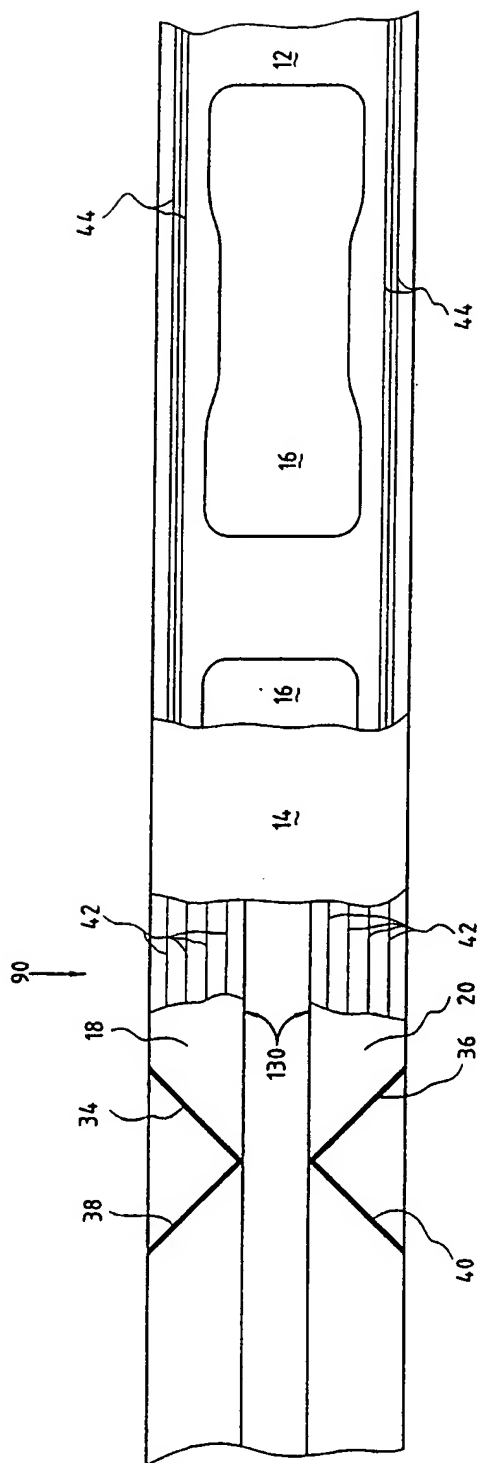
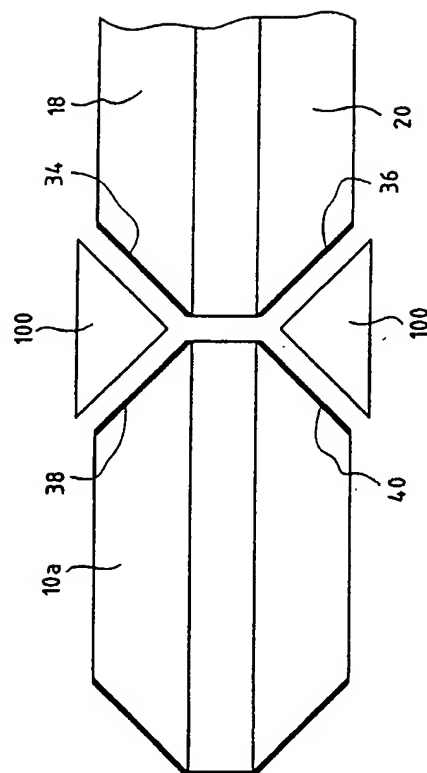


FIG. 6



Inter.      nal Application No  
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According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

**28 February 2000**

Date of mailing of the international search report

08/03/2000

Name and mailing address of the ISA  
European Patent Office, P.B. 6818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax (+31-70) 340-3018

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Inter      nal Application No

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